

## FINAL REPORT

## PROJECT TITLE:

"Application of stable isotope measurements to the study of the origin and history of meteorites"

## PRINCIPAL INVESTIGATOR:

Samuel Epstein  
Division of Geological and Planetary Sciences

## ACTIVITY PERIOD:

15 December 1992 to 14 December 1993

## AWARDEE INSTITUTION:

California Institute of Technology  
Pasadena, California 91125

## FEDERAL AGENCY NUMBER:

NASA NAGW-3329

## FINAL REPORT:

This document has been written to satisfy the requirements of a Final Report of NASA NAGW-3329. This grant was awarded as a probationary step, the consequence of which was to eventually determine if I would receive additional funding for the year 1993-94. The funding was reduced from \$110,000 to \$70,000 per year. This unfair and undeserved sequence of events has since been rectified by awarding me a three-year grant for \$107,000 per year, starting March 1, 1994. The decrease in funding for the period of 15 December 1992 to 14 December 93 resulted in a disruption of my normal research efforts supported by NASA. Our productivity was reduced significantly; in spite of this, we have been able to produce some interesting results which are documented by the enclosed two abstracts and three manuscripts. Two of these manuscripts, on the SNC and organic compounds, have been accepted for publication. The third manuscript is being handled by Dr. Burnett.

One of the programs which has been the subject of our research involves the isotopic analyses of hydrogen and carbon extracted from the SNC Meteorites. These analyses describe the history of CO<sub>2</sub> and H<sub>2</sub>O on Mars. The isotopic composition of hydrogen is of particular interest because it reflects the possible history of water on Mars as it is affected by the known degassing and loss of H<sub>2</sub>O that occurs in the atmosphere of Mars. The importance of this research has been appreciated by the scientific community; at two successive Lunar and Planetary Science meetings, the papers presented by Ms. Watson, our graduate student and senior author on these papers, were awarded the Second Best Student Paper in 1992 and the Best Paper in 1993. Some of this work is reported as two abstracts, and one manuscript which have been accepted for publication in *Science*.

The second scientific effort deals with the isotopic analyses of hydrogen, carbon and nitrogen in organic molecules extracted from meteorites to determine the origin and possible mechanisms of the formation of these compounds. The enclosed manuscript which has been accepted for publication with some modifications largely deals with ammonia and aliphatic amines, and shows an unusual enrichment in the deuterium and <sup>15</sup>N concentrations, indicating that the origin of these compounds involve as starting material

(NASA-CR-195843) APPLICATION OF  
STABLE ISOTOPE MEASUREMENTS TO THE  
STUDY OF THE ORIGIN AND HISTORY OF  
METEORITES Final Report, 15 Dec.  
1992 - 14 Dec. 1993 (California  
Inst. of Tech.) 5 p

N94-72037

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components of interstellar material. Our laboratory, in cooperation with Dr. Cronin in the Department of Chemistry and Biochemistry at Arizona State University, has been in the forefront of activity in identifying the unusual deuterium concentration in organic compounds from meteorites where the high enrichment of deuterium is characteristic of compounds identified by radioastronomers in interstellar clouds.

It has been our policy to interact with and to be helpful to our colleagues at Caltech and elsewhere by making our expertise and facilities available to them as they carry out their research. As an example of this, we include a manuscript from Dr. Burnett who generously included me as one of the authors and who bears the chief responsibility for reporting this research which deals with the interesting problem of the origin of  $\text{SO}_2$  in Io.

# CALIFORNIA INSTITUTE OF TECHNOLOGY

DIVISION OF GEOLOGICAL AND PLANETARY SCIENCES 170-25

RECEIVED

APR 1 1994

Contract Administrator

March 29, 1994

I. Dale Browne  
SN2  
NASA Johnson Space Center  
Houston, TX 77058

Re: Final Report for NASA NAGW-3329  
15 December 1992 to 14 December 1993

Dear Dr. Browne:

Enclosed please find the Final Report summarizing our research efforts over the past year on the project entitled "Application of stable isotope measurements to the study of the origin and history of meteorites," as well as copies of three (3) manuscripts and two (2) abstracts which document our results in detail. As explained in the Final Report, two of these manuscripts have already been accepted for publication.

The research efforts identified by NASA NAGW-3329 represent a continuation of the efforts identified by NASA NAG 9-46, and both of these awards have been acknowledged as appropriate in the attached manuscripts.

Sincerely,



Samuel Epstein  
William E. Leonhard Professor of Geology, Emeritus

cc: NASA Scientific & Technical Info. Facility  
Melvin E. Tyson/NASA/Washington

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